Center Innovation Fund: GRC CIF

Perovskite-based Photovoltaics: A New Pathway to Ultra- Low-Cost Space Power

Completed Technology Project (2017 - 2018)

Project Introduction

We will determine if the lifetime performance of new perovskite-based solar cells can be engineered for long-term performance for space applications. We will utilize cutting-edge designs for long lifetime, engineer our own samples, and characterize performance throughout standardized lifetime testing appropriate for space technology. Thin film solar cells have long held promise as enabling technology for flexible arrays and radiation hardness. The meteoric efficiency rise (reaching 22%1) for new solar cells in the perovskite structure family - from now on referred to simply as perovskites2 - represent an exceedingly attractive option for potential space applications. We envision this technology to enable the ubiquity of low-cost smallsats and CubeSats that can be utilized for power-hungry, high fidelity experiments and measurements. Mass production and automated assembly of these systems helps bring down cost and standardizes launch requirements. Additional applications include autonomous, roll-out solar arrays for extra-terrestrial surface deployments. In these two visions the current state of the art is disrupted by the thin, flexibility of perovskites, their ease of fabrication and high efficiency. The goal is to transfer the perovskite solar cells from research laboratory curiosity to potential game-changing, space qualified technology.

Anticipated Benefits

Ultimately the utilization of high efficiency thin film solar arrays are potentially transformational technology for large, direct drive SEP cargo tugs that traverse a host of different radiation conditions. Mass production of these devices would be transformational for future large scale SEP spacecraft as these devices significantly reduce cost overhead in power generation and enable high voltage operation. These properties could enable direct-drive SEP operation reducing weight over SOA by ~35%.

Perovskite-based Photovoltaics: A New Pathway to Ultra- Low-Cost Space Power

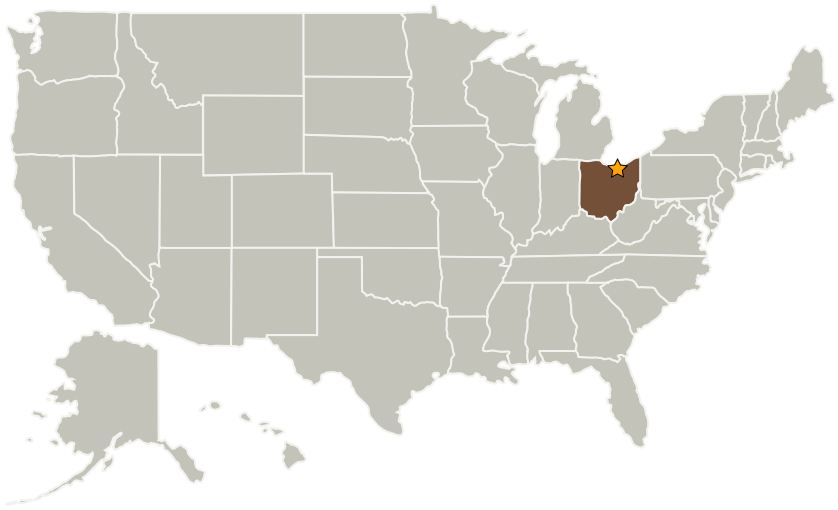
Table of Contents

Center Innovation Fund: GRC CIF

Perovskite-based Photovoltaics: A New Pathway to Ultra- Low-Cost Space Power

Completed Technology Project (2017 - 2018)

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Glenn Research Center(GRC)	Lead Organization	NASA Center	Cleveland, Ohio
California Institute of Technology(CalTech)	Supporting Organization	Academia	Pasadena, California
Case Western Reserve University	Supporting Organization	Academia	Cleveland, Ohio
Kent State University at Kent	Supporting Organization	Academia	Kent, Ohio

Primary U.S. Work Locations
Ohio

Project Transitions

October 2017: Project Start

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Glenn Research Center (GRC)

Responsible Program:

Center Innovation Fund: GRC CIF

Project Management

Program Director:

Michael R Lapointe

Program Managers:

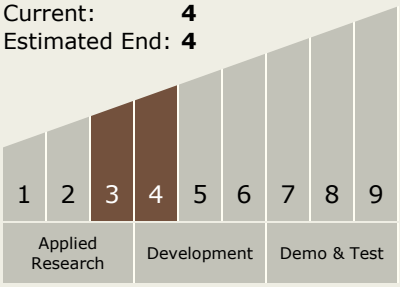
Kurt R Sacksteder
Gary A Horsham

Principal Investigator:

Timothy J Peshek

Technology Maturity (TRL)

Start: **3**
Current: **4**
Estimated End: **4**



Perovskite-based Photovoltaics: A New Pathway to Ultra- Low-Cost Space Power

Completed Technology Project (2017 - 2018)

September 2018: Closed out

Closeout Summary: The feasibility of perovskite solar cells for space applicatio ns was demonstrated. Further we demonstrated that the perovskite solar cell te chnology has certain advantages over the current state of the art, including pote ntial for flexibility, custom designs, and greater radiation hardness than SOA. Th e critical issue is the durability of the material. As a result of this project there is a path forward for the engineering of durable perovskite materials that is bolster ed by data and modeling. The current maturity is TRL 4.

Project Website:

https://www.nasa.gov/directorates/spacetech/innovation_fund/index.html#.VC

Technology Areas

Primary:

- TX10 Autonomous Systems
  - TX10.3 Collaboration and Interaction
    - TX10.3.4 Operational Trust Building

Target Destinations

Earth, Mars